Corridor Integrated Weather System (CIWS)

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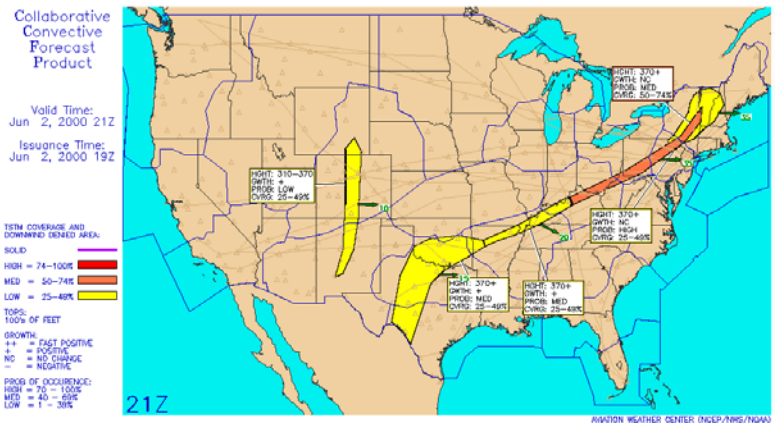
Outline

- Motivation
- New system features in 2002
  - Precipitation
  - Echo tops map
  - Forecast upgrades
- The next frontier: integration with ATM decision support and CDM CR tools
  - Route Availability Planning Tool (RAPT)
  - Status of integration with CR/TFM tools

CIWS Complements the FAA/Airline "Spring 2K & 2K+1" Plans

Collaborative Convective Forecast Product (CCFP)



Strategic Planning

CCFP

"Play book"

Play book is response to weather pilots cannot penetrate

FAA/Airline Strategic Planning Team

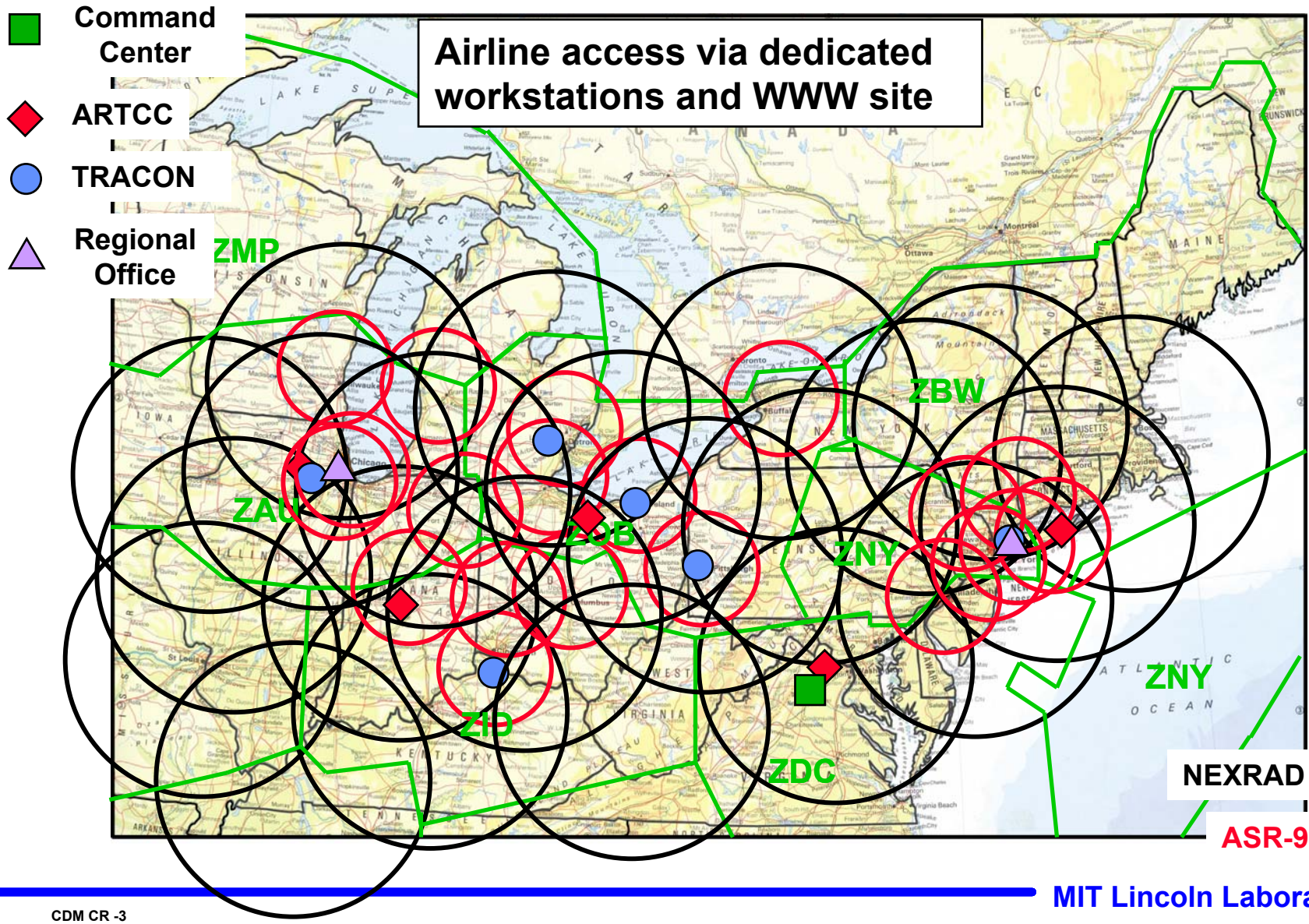
Strategic Plan

Teleconference Every 2 hours

Tactical responses/adjustments are required about 97 % of time in congested corridors

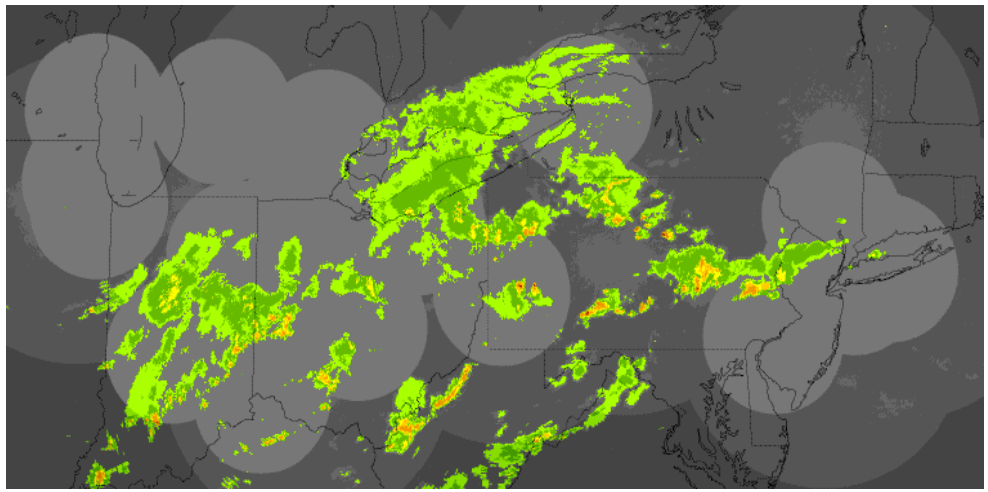
CIWS provides "tactical" support for routing and delay programs that were not in the strategic plan or, represent modifications to the plan

CIWS Sensors and Users Summer 2002



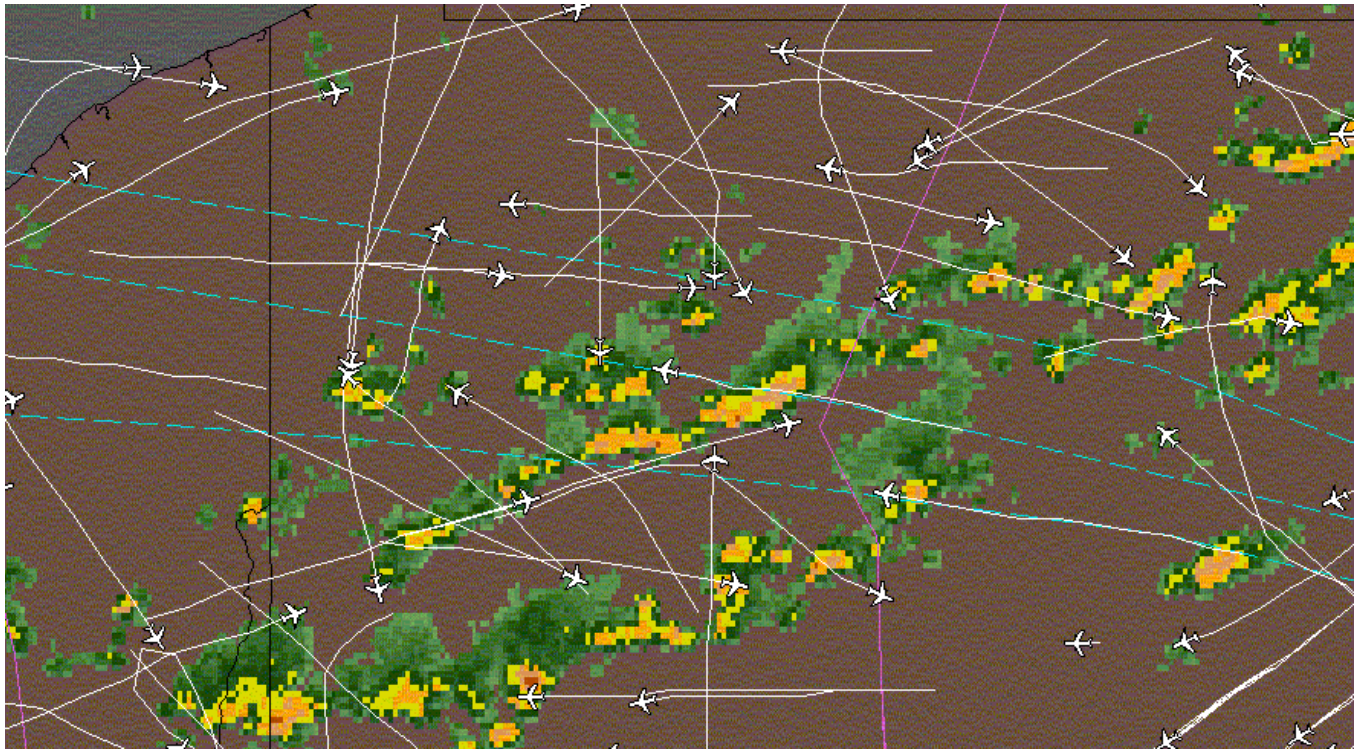
ASR/ARSR/NEXRAD Mosaic

- Mosaic of ASR-9 and ARSR-4 radars is combined with NEXRAD VIL mosaic.
- NEXRAD vertical integrated liquid (VIL) product is a much more accurate depiction of storm severity than current operation products (e.g., ETMS, WARP)



- High spatial resolution (1 km) to support en route and terminal usage
- Provides high update rates (1/minute) desired by NATCA in all regions where the FAA has a rapid update radar

Why Storm Tops Are Important

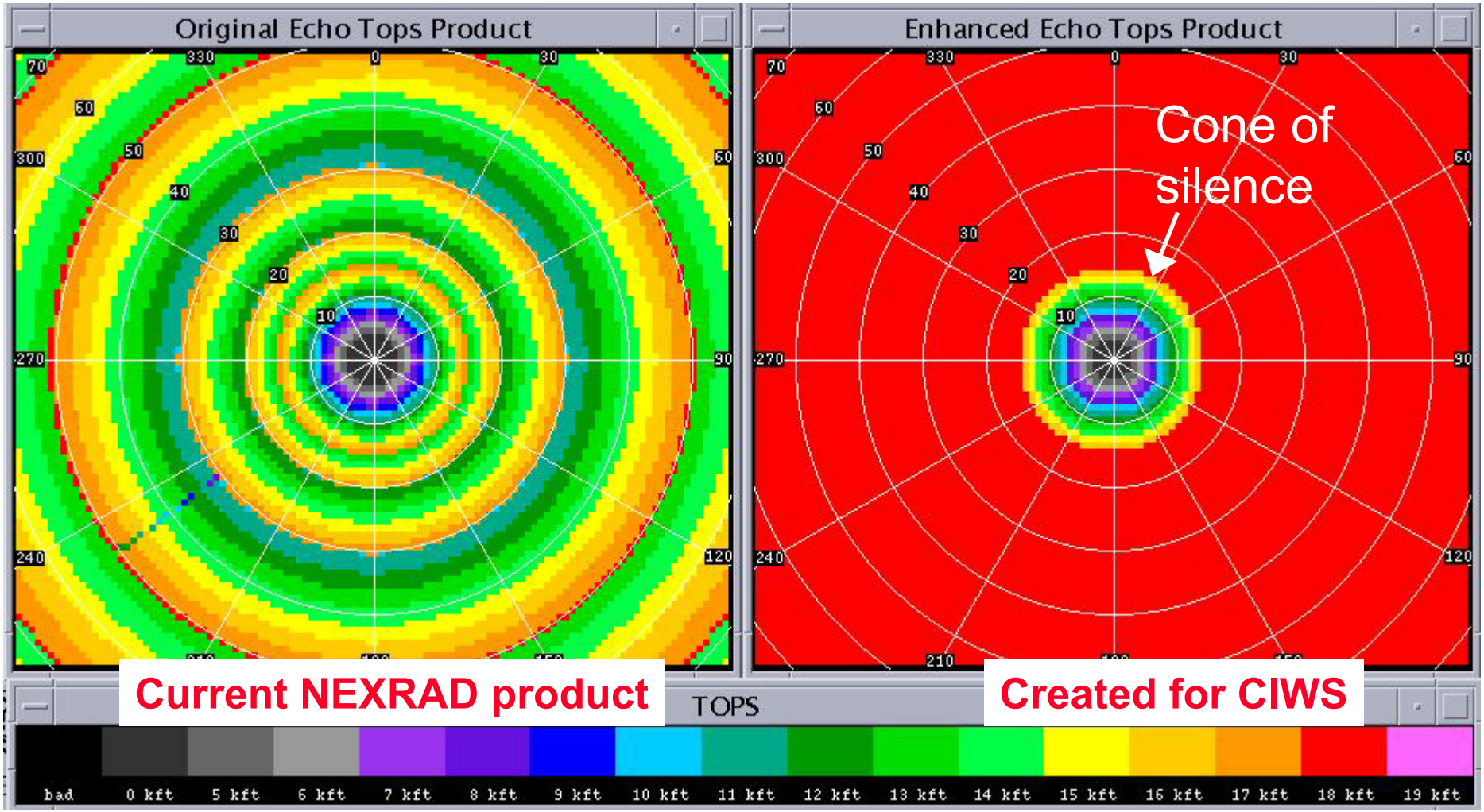


Flight Explorer WSI precipitation and flight tracks 2000Z on 24 August 2002

Note flights apparently passing through intense squall line in Pennsylvania

Accuracy of NEXRAD Echo Tops

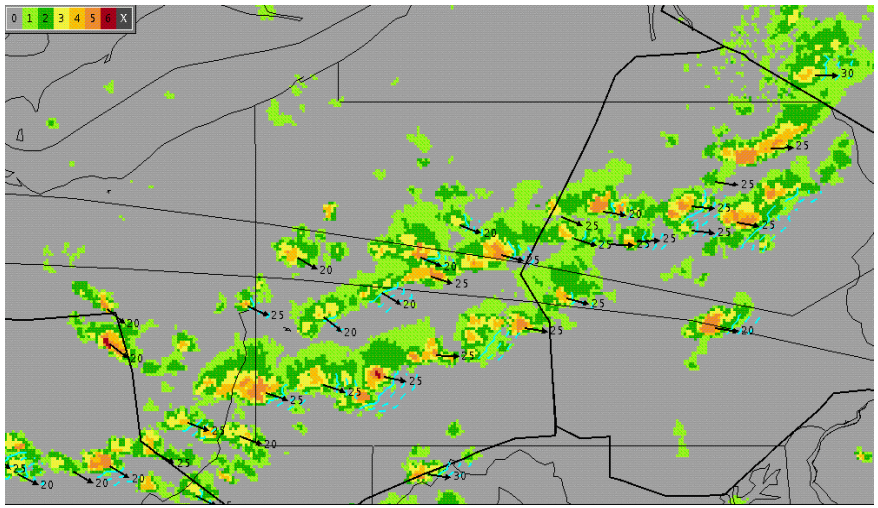
Synthetic storm with 18 kft tops



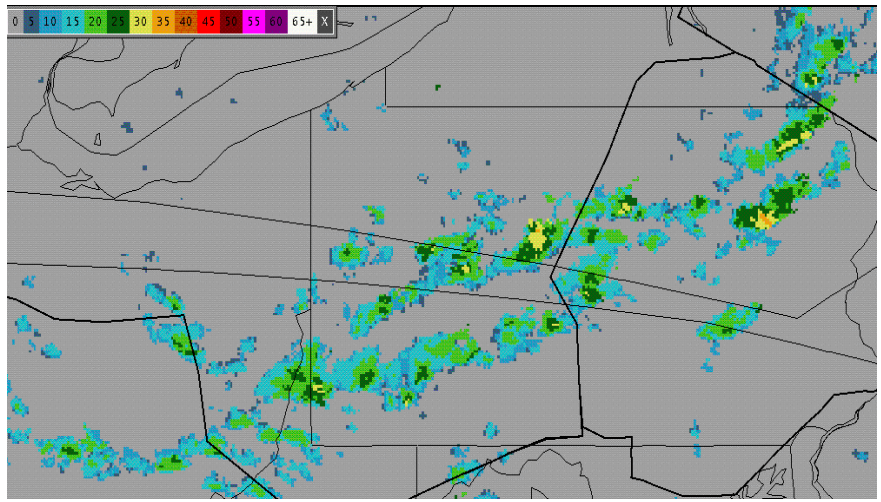
1000’ color bins

CIWS Products 24 August 2002

2000 Z



NEXRAD VIL

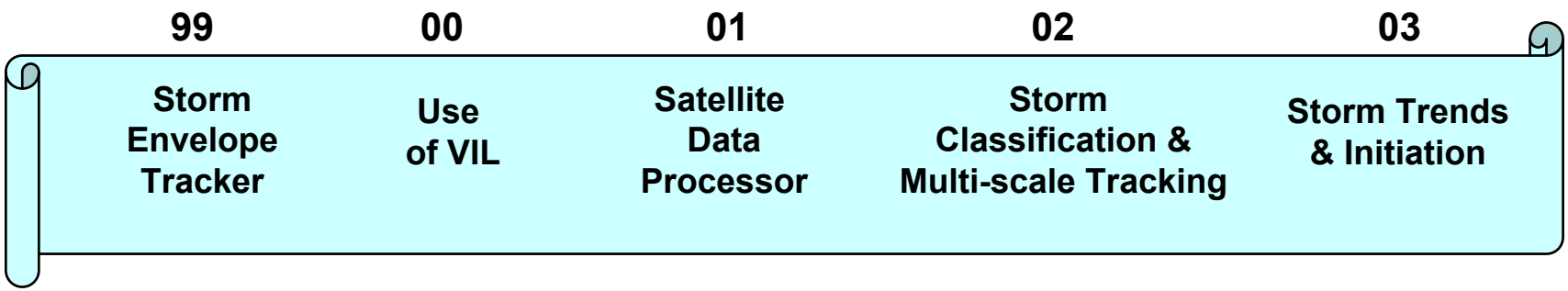


Echo Tops Map

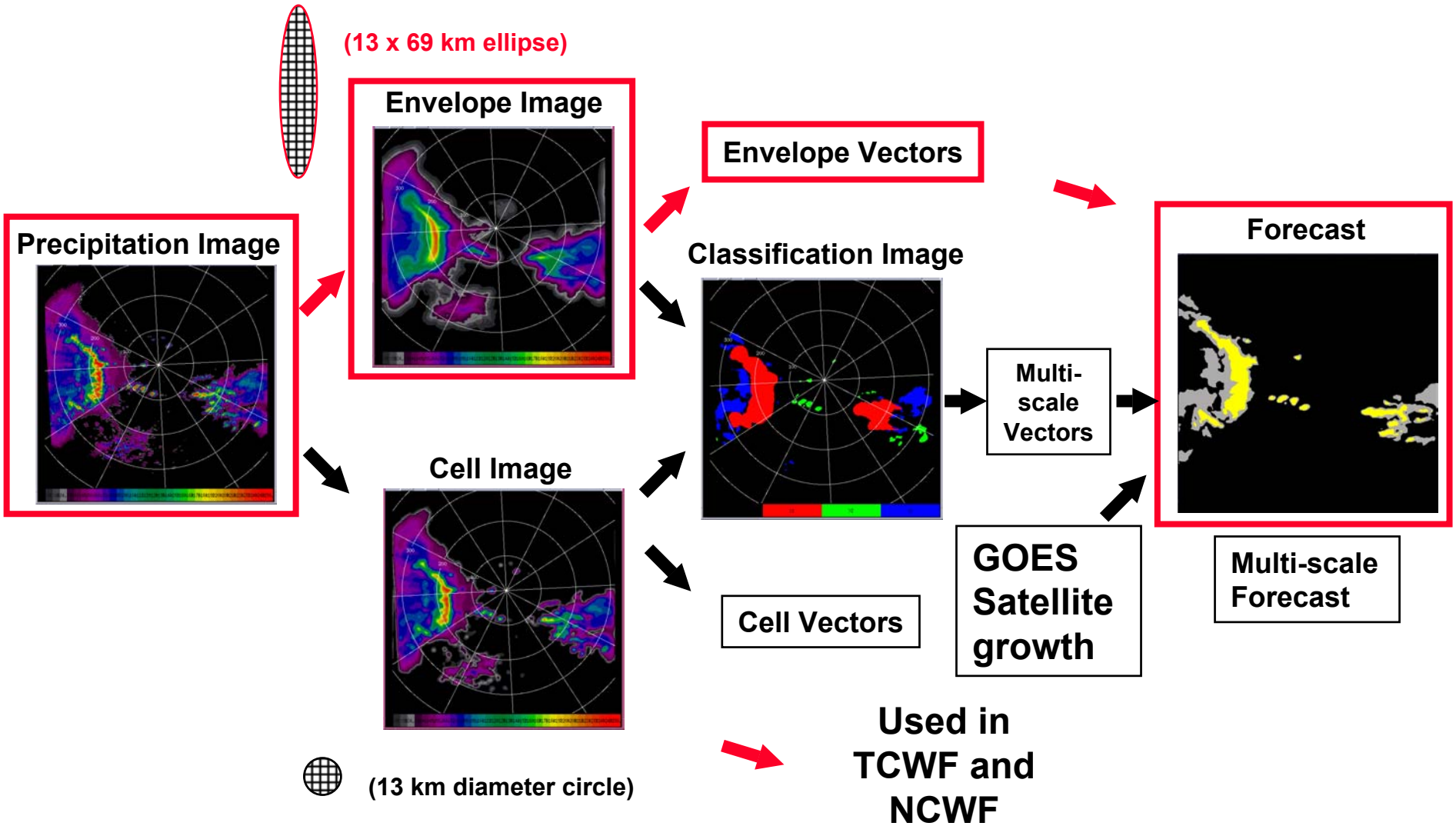
Echo tops map color code is chosen so echo tops of 30 kft corresponds to level 3 precip

CIWS Thunderstorm Forecasting

- **Key elements of CIWS 1-2 hr forecast**
  - **Multi-scale motion**
  - **Storm growth and decay trends**
  - **Boundary layer forcing**

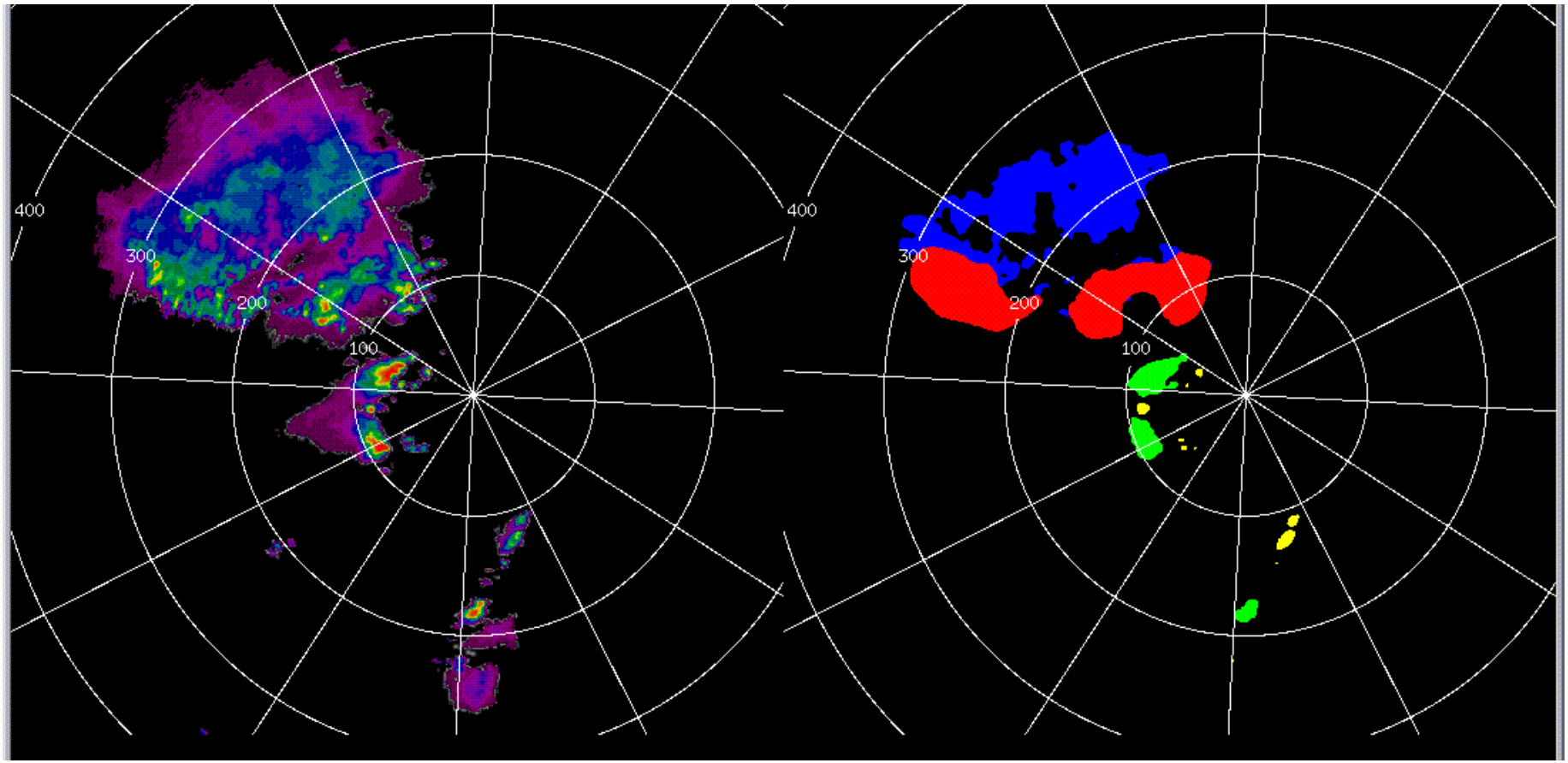


CIWS Multi-scale Track/Forecast



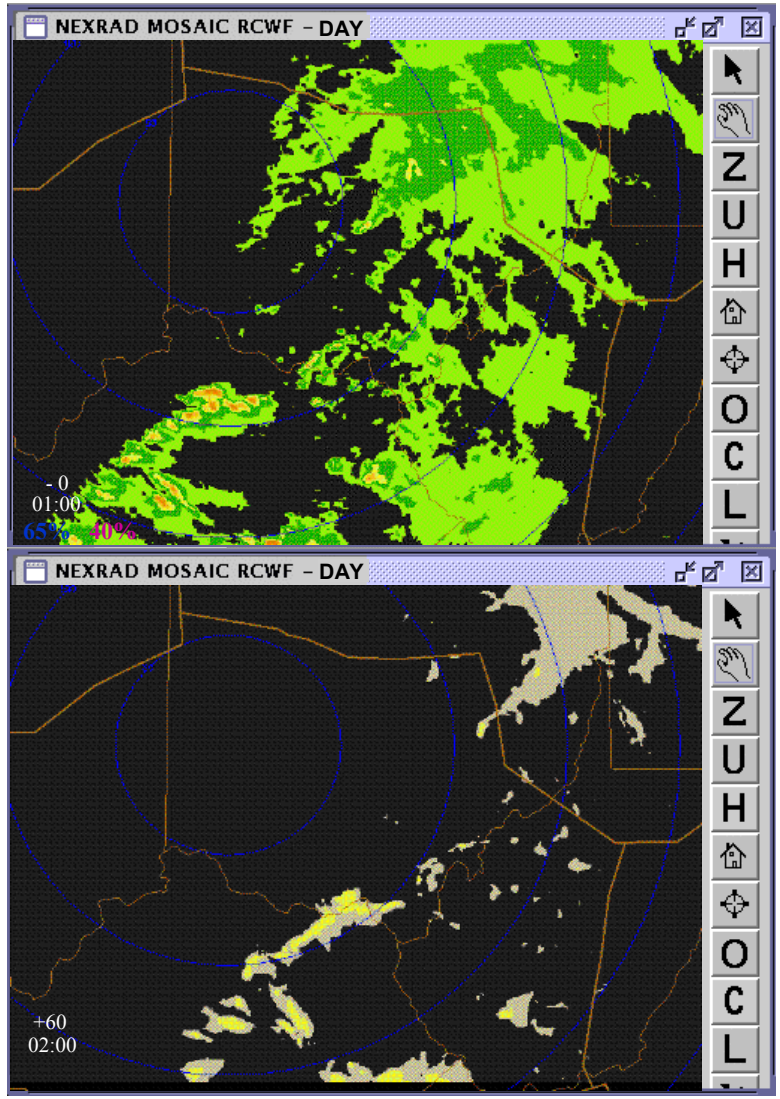
Storm Classification

Red = Line **Green = Large Cells**
Blue = Stratiform **Yellow = Small Cells**

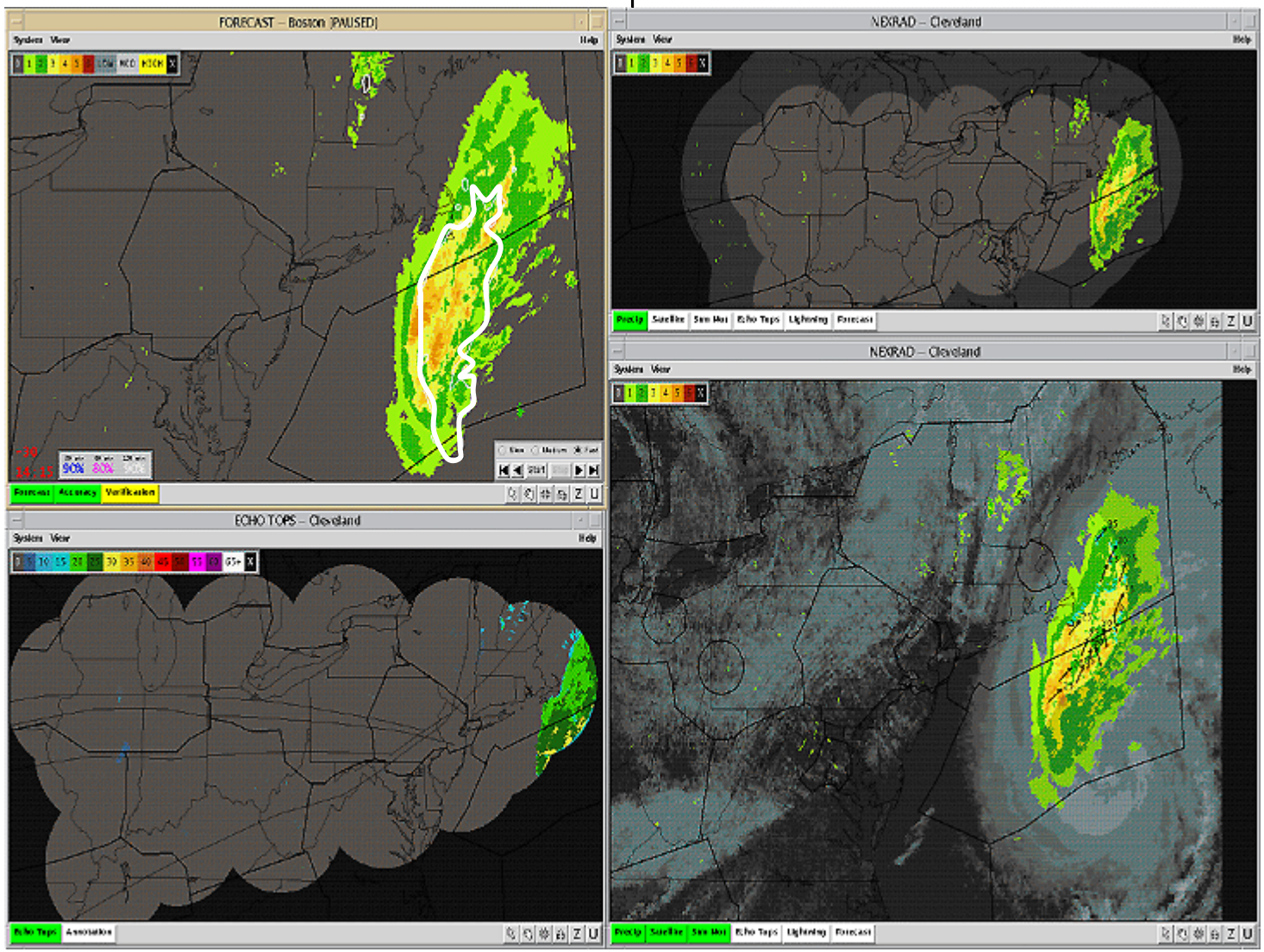


Regional Convective Weather Forecast

- High (solid yellow) and moderate (stippled yellow) probability of level three and greater weather.
- Two-hour forecast of envelope motion in 15-minute increments.
- Displays up to 60 minutes of past weather in standard six-level colors.
- Forecast Accuracy is past performance given in percent: blue for 30-minute forecast, magenta for 60-minute forecast, white for 120-minute.
- System currently uses satellite data for squall line growth; explicit growth and decay based on radar trends will commence in November 2002



2-hr Forecast for Large Organized Storm



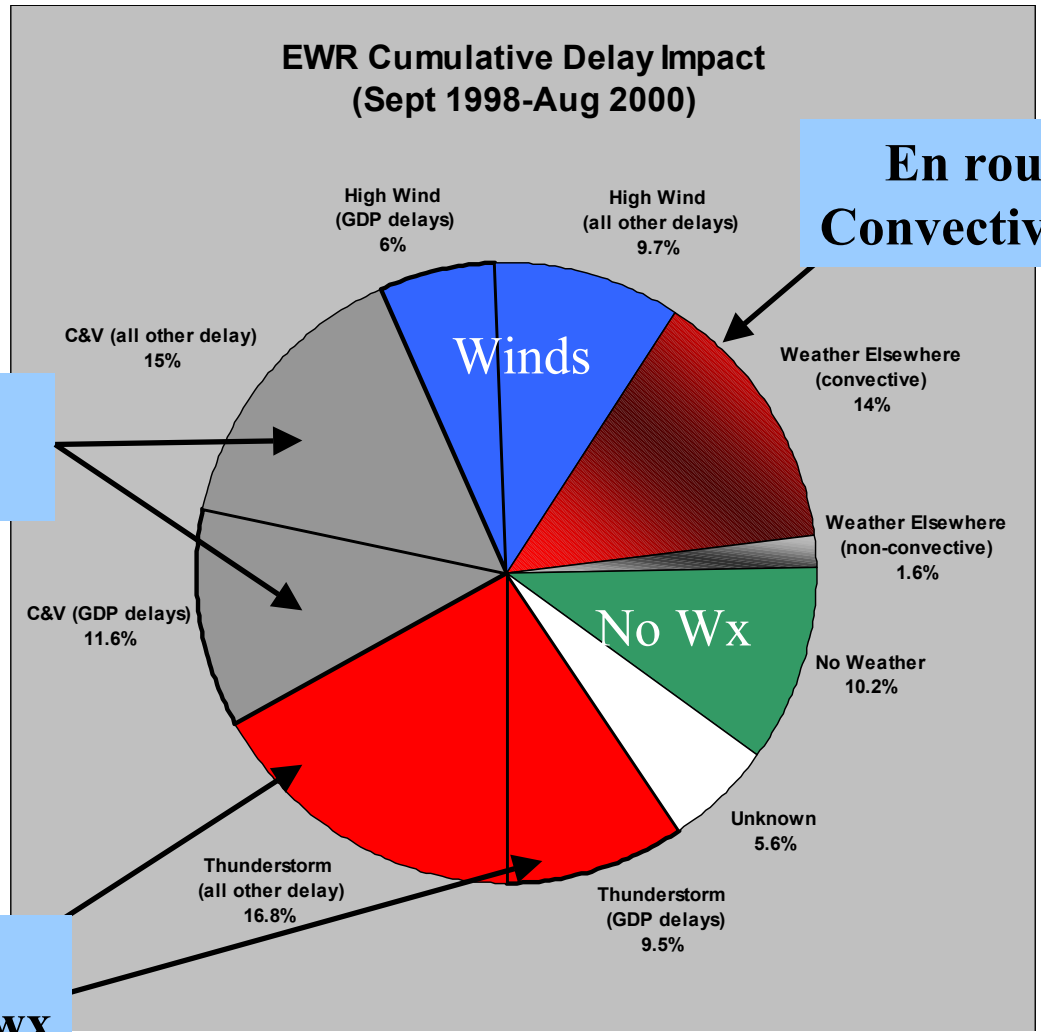
CIWS Summary

- CIWS is a concept exploration that focuses on “tactical” convective weather handling in highly congested airspace
- CIWS has demonstrated advanced precipitation mosaics, storm tops and forecast products
  - Echo tops results are particularly important
- Operational evaluation focuses on TFM at ARTCCs, Command Center and major TRACONs
  - Significant delay reductions have been demonstrated on many occasions in 2002
  - Quantitative delay reduction benefits assessment underway
- Major thrusts for FY03
  - Operational implementation option assessment
  - Expansion of coverage to southeast (to cover all of ZDC)
  - Introduction of forecasts with predictions of storm growth/decay
  - Use by small airports using Web browser technology
  - ATM integration with CIWS (e.g., RAPT)

Weather/ATM Integration (suggested by CIWS user's group)

	2002	2003 and beyond
Determine weather impact	CIWS/ITWS/NCWF	CIWS with convective initiation
Determine ATC impact	ETMS (CRCT)	enhanced ETMS
Develop mitigation plans	manual	routing and traffic flow tools (e.g. RAPT, CRCT)
Decide on mitigation plan	manual	decision support tools
Execute mitigation plan	manual	traffic flow/automation integration (e.g. URET)

Causes of Delay at Newark 1998-2000

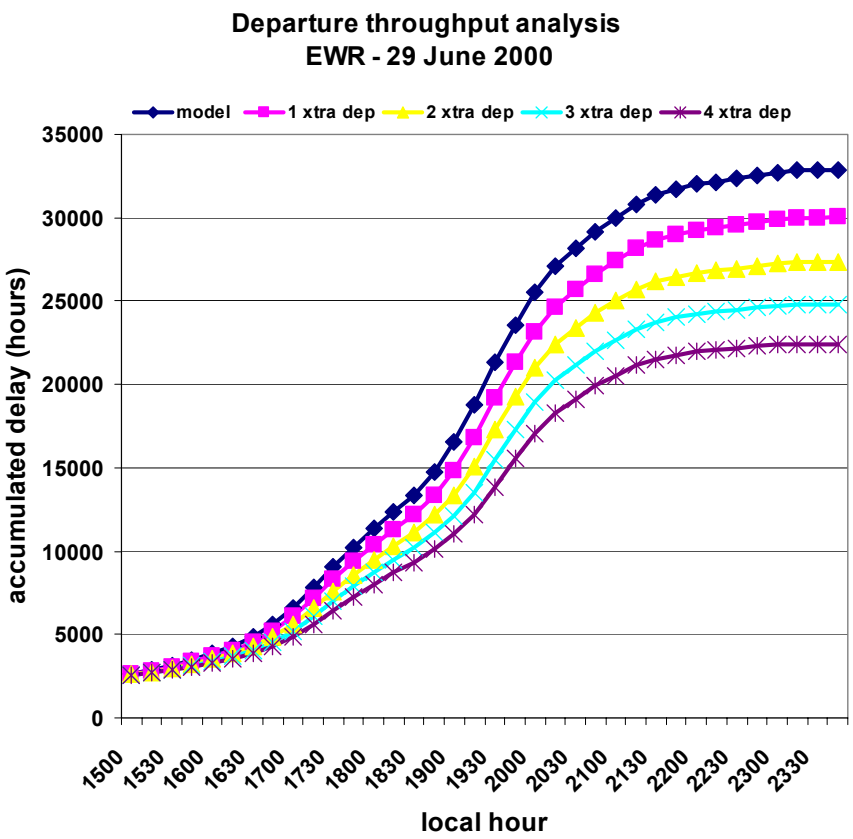


En route Convective wx

Low ceilings/ visibility

Terminal Convective wx

Benefits of Increased Departure Throughput



	Hours of delay saved				
Throughput increase	EWR	LGA	JFK	TEB	N90
+1 dep	*50*	*50*	*50*	*30*	***180***
+2 dep	*95*	*90*	*90*	*60*	***365***
+3 dep	*135*	*130*	*130*	*90*	***485***

Increasing departure rate by 3 aircraft per hour cuts departure delay by a third!

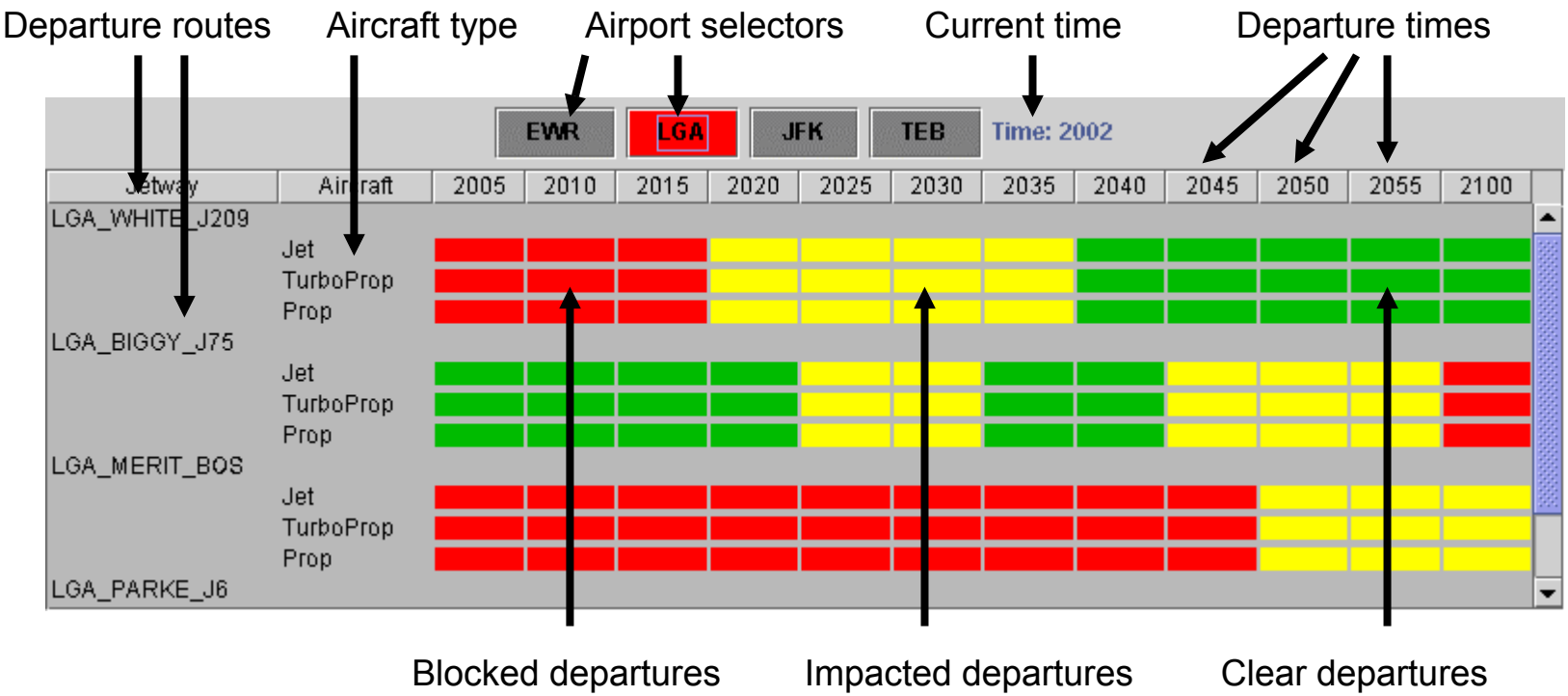
What is RAPT?

- **Answers the following questions…**
  - **If an aircraft is released, will that aircraft encounter convective weather along its flight path in the en route environment?**
  - **How is the weather evolving as the aircraft flies along its path?**
- **Using the following information…**
  - **Convective Weather Forecasts (TCWF)**
  - **Detailed definitions of nominal routes**
  - **Time-to-fly estimates (ETMS)**

Getting Departures Out of Major Terminals During a SWAP

- The New York ITWS identified a very high benefit associated with higher departure rates during severe weather avoidance program (SWAP) ($ 55 M per year)
- The benefit was constrained by need to coordinate departures in en route and terminal airspace
- High workload associated with manually determining route availability in dynamic weather situations limits achieved benefit

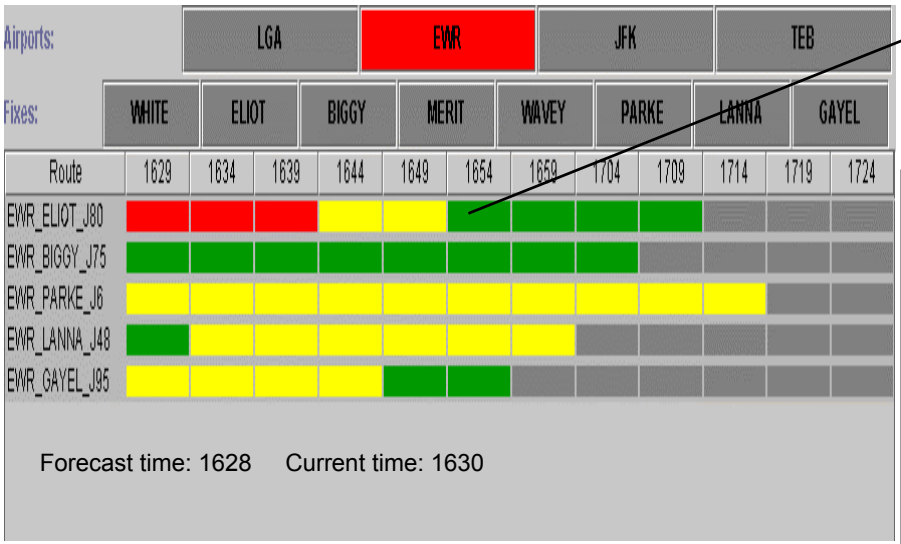
Route Availability Planning Tool (RAPT)



- **Airport departure timeline table**
  - **Predicted status for each departure route / aircraft / time**
  - **Click on timeline segment to show departure movie**

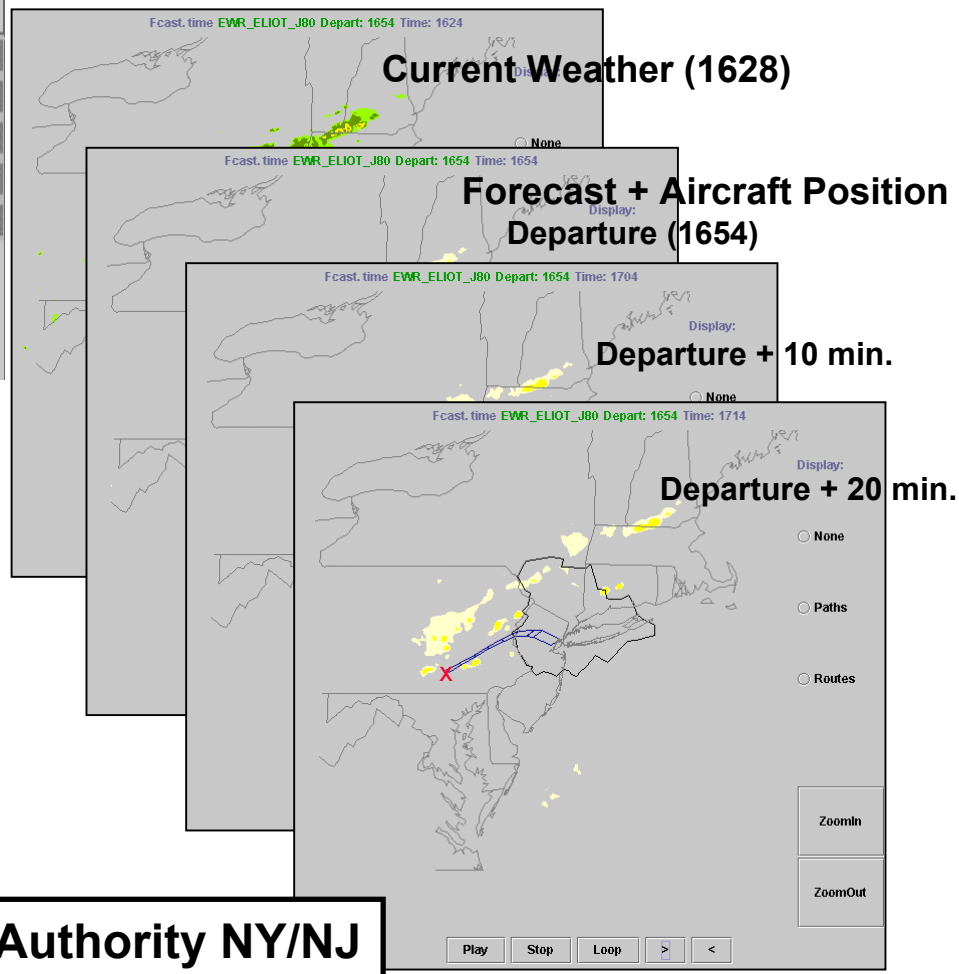
Initial development funded by Port Authority NY/NJ

Route Availability Planning Tool



Route + Weather Forecast Animation

- Forecast time: 1628 Departure: 1654
- Status: CLEAR



Departure Timeline Status Display

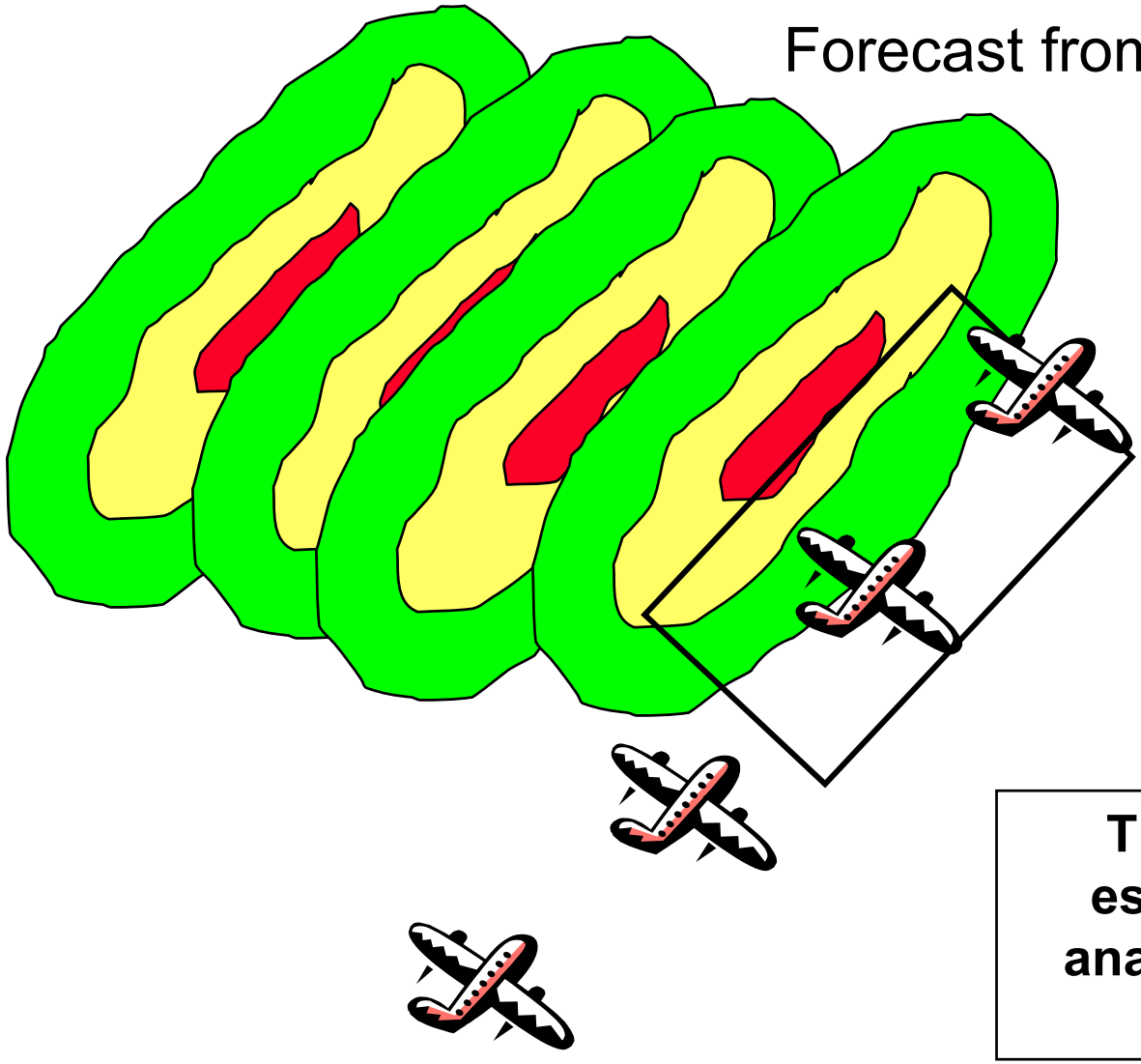
- Time line shows which routes are clear as a function of time
- User clicks on a route and candidate departure time to see an animation of
  1. the projected plane location and,
  2. the forecast weather locations

  at various times in the future

Initial development funded by Port Authority NY/NJ

Flight Impacted

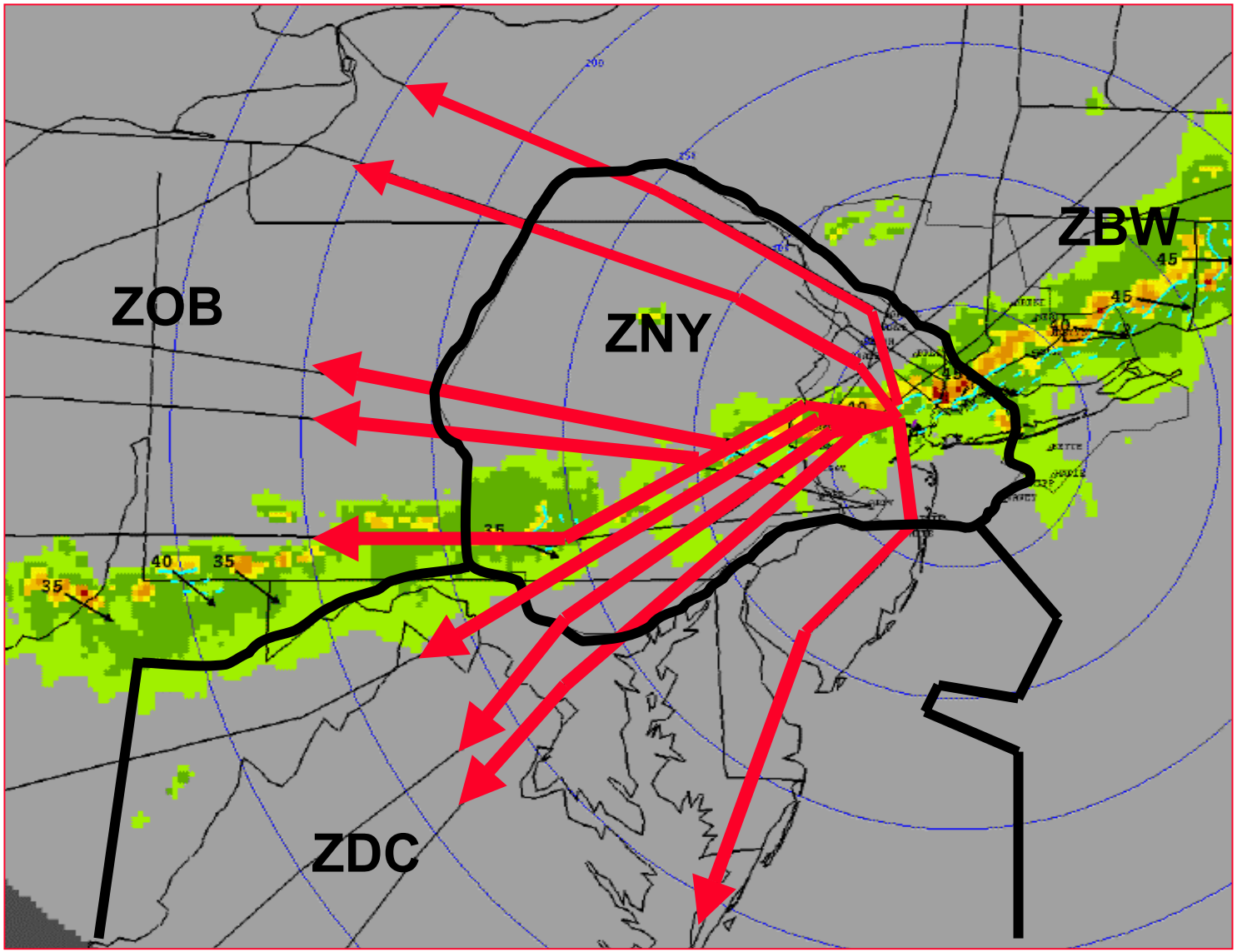
Forecast from ITWS or CIWS



Time of Flight estimated from analysis of ETMS data

Initial Range of RAPT

-30 minute flying time



ATC User Reaction to RAPT

- Very positive
- Usage
  - LGA used RAPT to call N90 and suggest a route would be open in 20 minutes on first day of use
  - August 24, RAPT saw extensive use by N90 as cold front crossed region. It was used to coordinate route openings with ZNY
- Convection has been mainly airmass, ie low-confidence forecast
- Training is still being coordinated with towers and ZDC
- Multi-facility usage is limiting factor in benefits

Integration with CDM CR Process

- Working to enhance common situational awareness with airlines
  - Upgrades to CIWS WWW/CDM sites underway
  - RAPT available on dedicated NY ITWS user displays; may be available on Web site

- No activity is underway at this time to integrate CIWS/RAPT with current CDM CR tools

- Expectation is that CIWS 2-hour forecast will be more accurate and operationally useful than 2-hour CCFP for CR decisions by mid summer 2003